What is claimed is:

1. A microbead particle system for bioassay comprising:

at least one microbead particle made of polymeric material;

a pattern encoded on at least one portion of said at least one microbead particle;

a selected geometry effectively associated with said at least one microbead particle, said geometry capable, alone or with other artifacts, of identifying said at least one microbead particle; and

means effectively associated with said at least one microbead particle for enabling or enhancing chemical conjugation between said at least one microbead particle and a ligand.

2. The microbead particle system as defined in claim 1 wherein said polymeric material is selected from the group consisting of thermoplastics, thermosets, photocrosslinkable resins, photopolymerizable resins, and organosilicon resins.

3. The microbead particle system as defined in claim 1 wherein said pattern is encoded in at least one dimension or within said portion.

4. The microbead particle system as defined in claim 1 further comprising at least one layer of material on or within said polymeric material, said at least one layer of material including material selected from the group consisting of dielectric materials, SiO_2, TiO_2, tantalum pentoxide, aluminum silicate, titanium nitride, metals, silver, gold, copper, nickel, palladium, platinum, cobalt, rhodium, iridium, photoluminescent compounds, aluminum tris (8-hydroxyquinoline), hydroxyquinoline aluminium chelate, *N*-*p*-methodxylphenyl-*N*-phenyl-*p*-methodoxylphenyl-stryrylamine, diphenyl-*p*-t-butylphenyl-1,3,4-oxadiazole, 4-dicyanomethylene-2-methyl-6-(*p*-dimethylamino styryl)-4*H*-pyran, and polymer blends containing photoluminescent polymers, poly(phenylenevinylenes), poly(fluorenes), and polythiophenes.

5. The microbead particle system as defined in claim 4 wherein said at least one layer of material is electromagnetically transducing, said at least one layer of material having a

measurable response to electromagnetic excitation, said measurable response formed according to said pattern.

6. The microbead particle system as defined in claim 4 wherein said at least one layer of material includes at least one surface suitable for chemical conjugation with a ligand.

7. The microbead particle system as defined in claim 1 wherein said pattern is symmetrical.

8. The microbead particle system as defined in claim 1 wherein said pattern is a preselected pattern capable of generating a diffractive image.

9. The microbead particle system as defined in claim 1 wherein said pattern comprises at least one unit cell, said at least one unit cell being repeated on at least part of said at least one portion, said pattern capable of generating a diffractive image.

10. The microbead particle system as defined in claim 9 wherein said pattern is capable of generating the diffractive image as long as a region of said pattern is illuminated by a beam having at least the same size as said at least one unit cell, said at least one unit cell capable of being illuminated at an angle.

11. The microbead particle system as defined in claim 1 wherein said pattern comprises a plurality of regions, said plurality of regions being capable of producing a plurality of electromagnetic responses, said plurality of electromagnetic responses generating a binary code.

12. The microbead particle system as defined in claim 11 where said plurality of electromagnetic responses is selected from the group consisting of reflectivity, light absorption and photoluminescence.

13. The microbead particle system as defined in claim 1 wherein said geometry comprises a pre-selected surface shape and size, said geometry enabling seating in a receiving substrate in a manner effective for particle identification.

14. The microbead particle system as defined in claim 13 wherein said pre-selected surface shape and size is selected from the group consisting of triangles, circles, squares, crosses, diamonds, parallelograms, and semicircles, wherein said pre-selected surface shape is used in combination with a treatment selected from the group consisting of color dyes, color absorbing dyes, pigments, and dielectric coatings, said treatment creating an interferometric or holographic color pattern.

15. The microbead particle system as defined in claim 1 wherein said at least one portion is a transducing layer or a digital data layer, said transducing layer or digital data layer further comprising:

a protective layer laid on top of said transducing layer or said digital data layer;

wherein said digital data layer, either cooperating with said transducing layer or acting as said transducing layer, produces a detectable response signal when exposed to energy, wherein said transducing layer or said digital data layer is made of material selected from the group consisting of silver, indium, antimony, and tellurium, wherein said transducing layer or said digital data layer is coated with photo-sensitive dye that is burned with a laser according to a pre-selected pattern of 1's and 0's.

16. The microbead particle system as defined in claim 1 wherein said pattern represents ridges and troughs corresponding to pre-selected constructive and destructive interference patterns, a relationship between said ridges and troughs being a function of refractive index of said polymeric material, refractive index of a medium through which the depth of said pattern is measured, and the wavelength of light impinging on said pattern.

17. The microbead particle system as defined in claim 1 wherein said at least one portion further comprises:

a first embossed polymeric material having a first inner surface opposing a first patterned surface; and

a second embossed polymeric material having a second inner surface opposing a second patterned surface,

wherein said first inner surface forms a bond with said second inner surface.

18. The microbead particle system as defined in claim 1 further comprising said at least one microbead particle being marked after binding with an analyte, said at least one microbead particle being identified by the emission of dyes or luminescent molecules associated with the analyte.

19. The microbead particle system as defined in claim 1 wherein said at least one portion comprises a metallic layer or a dielectric stack

20. A method for fabricating at least one polymeric microbead comprising the steps of:

creating a patterned master substrate having at least one pattern and at least one shape, the at least one pattern having at least one level of pattern depth, the at least one shape enabling identification and proper seating in a receiving substrate;

applying polymeric material to the patterned master substrate to form at least one patterned polymeric microbead or at least one patterned microbead precursor;

partitioning the polymeric material to form the at least one polymeric microbead; and

releasing the polymeric material from the master substrate.

21. The method as defined in claim 20 wherein said step of applying polymeric material to the patterned master substrate is performed according to a process selected from the group consisting of embossing, casting a liquid resin onto the patterned master substrate, injection molding a liquid resin onto the patterned master substrate, and infusing a liquid resin into a gap formed between the patterned master substrate and a second substrate.

22. The method as defined in claim 20 wherein said step of partitioning the polymeric material to form the at least one patterned polymeric microbead is a process selected from the group consisting of dry etching the polymeric material, cutting the polymeric material using laser ablation, and dissolving the polymeric material surrounding the at least one patterned polymeric microbead.

23. The method as defined in claim 20 wherein said step of creating at least one level of pattern depth comprises:

creating a first depth that defines a plurality of features; and

creating a second depth that defines at least one labeling code, the second depth being deeper than the first depth.

24. The method as defined in claim 20 wherein said step of applying the polymeric material to the patterned master substrate further comprises the steps of:

casting a liquid resin onto the patterned master substrate; and

hardening the liquid resin to form a micropatterned polymeric substrate.

25. The method as defined in claim 20 wherein said step of applying the polymeric material to the patterned master substrate further comprises the steps of:

injection molding a liquid resin onto the patterned master substrate; and

hardening the liquid resin to form a micropatterned polymeric substrate.

26. The method as defined in claim 25 further comprising selecting the liquid resin from the group consisting of epoxide-based resist, silicon-based resins, silsesquioxanes, poly(dimethylsiloxane) (PDMS), poly(phenylmethylsiloxane), phenolic resins, novolac resins, epoxides, bisphenol A-based resins, urethane acrylates, acrylates, ultra-violet adhesives, optical adhesives, thermoplastic resins, polystyrene, poly(methyl methacrylate), polycarbonate, thermoplastic polyimides, poly(ethylene terephthalate), polyurethanes, poly(ether ether ketone), and polyethylene.

27. The method as defined in claim 20 further comprising the step of providing at least one layer of material on top of the polymeric material.

28. The method as defined in claim 20 further comprising selecting a material for the patterned master substrate from the group consisting of silicon, quartz, aluminium oxide, glass, metals such as stainless steel, copper, chromium, nickel, and brass.

29. A microbead being formed according to the method of claim 20.

30. A reader for identifying at least one microbead comprising:

a receiving substrate, said receiving substrate including at least one receptor having at least one geometric shape, said at least one receptor capable of receiving at least

one microbead with a portion having a geometry corresponding to said substrate receptor geometry;

a magnifier capable of enlarging an optical, electrical, pressure, sonic or magnetic image of the received at least one microbead or a portion thereof; and

a recorder capable of storing an enlarged image of the received at least one microbead or portion.

31. The reader as defined in claim 30 wherein said at least one receptor is selected from the group consisting of a well, a treated portion of said receiving substrate, and a protrusion.

32. A method for identifying at least one microbead comprising:

initially etching a receiving substrate through a first patterned mask, said step of initially etching forming a shaped opening, the shaped opening having a pre-selected geometry;

subsequently etching the receiving substrate through a second patterned mask, said step of subsequently etching enlarging the shaped opening;

creating a master substrate having at least one pattern, the master substrate having the pre-selected geometry, the at least one pattern having at least one level of pattern depth;

applying polymeric material to the master substrate to form the at least one microbead;

partitioning the polymeric material to release the at least one microbead;

releasing the polymeric material from the master substrate;

providing the at least one microbead to the shaped opening; and

viewing the at least one microbead to read the at least one pattern.

33. The method as defined in claim 32 further comprising the steps of:

forming the shaped opening having a top surface and a bottom surface;

forming a beveled edge at the top surface; and

forming the bottom surface smaller than the top surface.